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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/553,997	04/20/2000	Douglas A. Buchanan	13322(YOR92000-0036US1)	5913

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EXAMINER

VOCKRODT, JEFF B

ART UNIT

PAPER NUMBER

2822

DATE MAILED: 04/10/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/553,997

Applicant(s)

BUCHANAN ET AL.

Examiner

Jeff Vockrodt

Art Unit

2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 March 2002.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-56 is/are pending in the application.
- 4a) Of the above claim(s) 4-12 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-3 and 13-56 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

This office action is in response to the election filed March 27, 2002. Applicant's election of species I where R_1 is a hydride group is acknowledged. This species is readable on claims 1, 2, 3, and 13-56. Accordingly, claims 4-12 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected species, there being no allowable generic or linking claim. Election was made **without** traverse in Paper No. 3.

Claim Objections

Claims 18, 20, and 45 are objected to because of the following informalities:

Claims 18 and 20 recite the term "tetrahydroguran." The examiner thinks this is "tetrahydrofuran," clarification is requested.

Claim 45 recites compounds in a list more than once. For instance "TiSiN" and "TiAlN" is listed more than once.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-3 and 13-56 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 1 requires, inter alia, a precursor having the composition: $MR^1_xR^2_yA_z$; wherein "A is an optional coordinatively bound or associated ligand ... "(emphasis

added); and "z is ≥ 0 ." The fact that component A is claimed as optional conflicts with the further claim requirement that z cannot be equal to 0. While the term "optional" could conceivably be construed as describing choice between the type of ligands that make up component A, this superfluous construction of the term "optional" conflicts with the specification's use of the term in a similar context, thereby creating ambiguity as to what the claim is intended to cover. For instance, at page 20, lines 6-7, the specification reads, "A is an optional coordinatively bound ligand selected from ..." The term "optional" as used in the specification implies that z can be equal to zero in the formula $MR^1_xR^2_yA_z$. Since the claim is ambiguous on its face and a reading of the claim in light of the specification only exacerbates this condition, the claim is held indefinite under 35 U.S.C. §112, 2d paragraph. For the purpose of addressing prior art in this office action, and in order to advance prosecution, claim 1 will be read to include within its scope but not require component A. This is consistent with the specification's discussion that "[ligand] A is an optional coordinatively bound ligand ..." found in the paragraph bridging pages 19-20 of the specification.

Claims 29-32 are rejected under 35 U.S.C. 112 for failure to further limit the parent claims. To further limit their parent claims, claims 29-32 should specify which type of compound is selected from the group listed in claim 28. For instance, replace "wherein said reducing agent is" with "wherein said co-reactant is a reducing agent selected from the group..."

Claim 23 is rejected under 35 U.S.C. 112 2d paragraph for failure to further limit the independent claim on which it depends. Claim 23 includes metals such as Ce, Pr,

Nd, Sm, Eu, Gd, Tb, D (?), Ho, Er, Tm, Yb, Lu, Th, Pa, U, Np, Pu, Am and precursor compounds such as tri-bis(trimethylsilyl)erbium amide that are excluded from the scope of claim 1, which claim 23 depends. It is axiomatic that claim 1 must read on everything that claim 23 reads on, and any claim language which obscures this criteria renders the claim indefinite.

Claim 23 recites the element D (it is clear from context that this is not intended to mean deuterium). The examiner takes judicial notice that the element D is not among the known existing elements. Claim 23 is rejected under 35 U.S.C. 112 first paragraph for lack of enablement for compounds including D.

Claim 13 is rejected under 35 U.S.C. 112 2d paragraph for failure to limit the independent claim on which it depends. The optional coordinatively or associatively bound ligand A in claim 13 includes "aryl" while the close-ended list in the independent claim does not include "aryl."

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-3, 14-15, and 23-24 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Pat. No. 5,820,664 ("Gardiner").

Claims 1-3. Gardiner teaches precursor compositions for CVD and precursor solutions that are resistant to ligand exchange. In example 18, Gardiner teaches

adding an inert solvent to a "neat" liquid precursor. Specifically a precursor solution for CVD of aluminum comprising dimethyl aluminum hydride with hexane or toluene is prepared. Col. 17, ll. 30-42.

Claims 14-15. Hexane or toluene vaporizes at a higher temperature than dimethyl aluminum hydride. Hexane is a C₆ alkane.

Claim 23. Gardiner teaches, inter alia, dimethyl aluminum hydride.

Claim 24. Gardiner teaches using this precursor solution to deposit an aluminum film utilizing a CVD reactor.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-3 and 13-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 6,214,105 ("Hintermaier").

Hintermaier teaches a precursor dissolved in an alkyl solvent; the precursor can be Pt(thd)₂, Pt(hfac)₂, and (MeCN)₂PtMe₂. Col. 3, ll. 39-60.

The solvent is taught to consist of a mixture of A, B, and C. In a specific example the mixture is 5:4:1 octane:decane:polyamide. Col. 4, ll. 45-50.

Claim 15. The solvents can be selected to achieve a desired boiling point to accommodate the evaporation characteristics of a specific precursor. Col. 5, ll. 58-65.

Claim 16. The additive, component C, is 10% in the preferred embodiment.

Claim 17. The component C can be a polyamine. Col. 4, ll. 60-65.

Claims 18-22. Hintermaier teaches that the preferred amine species are trialkylamine and tetraalkyl ethylene diamine. The difference between the claimed species and the genus is such that one of ordinary skill in the art would instantly envisage the claimed species from the claimed genus. For example, claim 18 recites trimethyl amine while Hintermaier discloses trialkylamine. Methyl is the simplest and most readily apparent species of the alkyl class. It would have been obvious to one of ordinary skill in the art at the time of the invention to use trimethyl amine as the trialkyl amine of Hintermaier, because trimethyl amine is at once envisaged from the genus trialkyl amine as it is the simplest species of this genus.

Claim 23. Hintermaier teaches a precursor dissolved in a alkyl solvent; the precursor can be $\text{Pt}(\text{thd})_2$, $\text{Pt}(\text{hfac})_2$, and $(\text{MeCN})_2\text{PtMe}_2$. Col. 3, ll. 39-60.

Claim 24. Hintermaier teaches the precursors as CVD precursors. The term "optional" renders a co-reactant unnecessary to anticipate the claim.

Claims 25-43 and 47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hintermaier as applied to claims 1-3 and 13-24 above, further in view of U.S. Pat. No. 5,879,459 ("Gadgil").

Hintermaier teaches precursor and solvent compositions of chemical vapor deposition, including CVD of ferroelectric films. Hintermaier does not teach sequentially pulsing precursor, purge gas, and co-reactant into the CVD chamber.

Gadgil teaches a pulse pattern for depositing an AB type material from precursor gases Ax and By respectively. See Figs. 1a-1b. One cycle incorporates one pulse of

Ax and one pulse of By, each precursor pulse separated by a pulse of purge gas. Col. 3, ll. 29-37. This sequence avoids reactions between the precursors. Col. 3, ll. 50-55.

It would have been obvious to one of ordinary skill in the art at the time of the invention to pulse the A and B components with intervening purge gas pulses in the deposition of the SBT layer of Hintermaier, because this configuration avoids reactions between the precursors as taught by Gadgil.

Claims 43-48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hintermaier and Gadgil as applied to claims 25-43 and 47 above, further in view of U.S. Pat. No. 5,382,817 ("Kashihara").

Hintermaier and Gadgil teach a process of forming a ferroelectric capacitor using a precursor and solvent in an atomic layer deposition apparatus, but fail to teach certain other materials of the ferroelectric capacitor.

Kashihara teaches a ferroelectric capacitor, Fig. 30, having a tungsten plug 352, TiN barrier 353a (see col. 16, 1st paragraph), platinum lower electrode 314, ferroelectric layer 315, and a platinum upper electrode 316.

It would have been obvious to one of ordinary skill in the art at the time of the invention to include a tungsten plug, TiN barrier, platinum lower electrode, and platinum upper electrode in the ferroelectric stacked capacitor of Hintermaier, because these materials were well known and desirable materials for forming ferroelectric stacked capacitors as taught by Kashihara.

Claims 1-3, 14-15, 23-24, and 49-52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gardiner in view of U.S. Pat. No. 5,998,870 ("Lee").

Gardiner teaches a method of depositing an aluminum film using a dimethyl aluminum hydride precursor that is diluted in a solvent. Gardiner does not teach forming an aluminum wiring layer.

Lee teaches that dimethylaluminumhydride is used to form aluminum films that are made into wiring structures.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the process of Gardiner to form an aluminum wiring layer, because aluminum processes employing dimethylaluminumhydride were well known and desirable for forming aluminum wiring layers as taught by Lee.

Claims 53-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hintermaier and Gadgil as applied to claims 25, 26, 27, 39, 40, 41, 42, 43, and 47 above, further in view of U.S. Pat. No. 6067244 ("Ma")

Hintermaier and Gadgil teach a process of forming a ferroelectric capacitor using a precursor and solvent in an atomic layer deposition apparatus, but fail to teach using the ferroelectric layer in a ferroelectric field effect transistor.

Ma teaches a ferroelectric field effect transistors, Figs. 1(a)-3(c), that comprise a gate, a source, a drain, a channel, and a ferroelectric material as the gate insulator.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the ferroelectric layer process taught by Hintermaier and Gadgil to form a ferroelectric FET, because ferroelectric field effect transistors were well known and desirable uses for ferroelectric materials as taught by Ma.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jeff Vockrodt whose telephone number is (703) 306-9144. The examiner can normally be reached on Monday through Friday, from 8:30 Am to 5:00 Pm E.S.T.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached on (703) 308-4940. The fax phone number for this Group is (703) 305-3432 or (703) 308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

April 7, 2002

J. Vockrodt



Michael Trinh
Primary Examiner